

SPECIAL SPECIFICATION

SECTION 02200S

EARTHWORK

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Earthwork includes, but is not limited to clearing, preparing, grading, excavating, filling, backfilling and compacting of soils as necessary to accomplish finished construction as indicated on the drawings.
- B. Related Section: Refer to Division 3, Section “Cast-In-Place Concrete” for general excavation requirements.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - C131 Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
 - C136 Method for Sieve Analysis of Fine and Coarse Aggregates
 - D1557 Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-Mm) Drop
 - D4253 Test Methods for Maximum Index Density of Soils Using a Vibratory Table
 - D4254 Test Methods for Minimum Index Density of Soils and Calculation of Relative Density
 - D4318 Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- B. Code of Federal Regulations (CFR)
 - Title 29 Part 1926.650 Safety and Health Regulations for Construction

1.03 DEFINITIONS

- A. Borrow: Soil material obtained off-site when sufficient approved soil material is not available from excavations.
- B. Excavation: The removal of material encountered to subgrade elevations and the reuse or disposal of material removed.
- C. Structures: Building, footing, foundations, retaining walls, slabs or other man-made stationary features constructed above or below ground surface.
- D. Subgrade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil material.
- E. Unauthorized Excavation: Removing materials beyond indicated subgrade elevations or dimensions without direction by the Sandia Delegated Representative (SDR).
- F. Utilities: On site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.
- G. Flowable Concrete Backfill: Controlled low-strength flowable backfill with no less than 6 inch (152 mm) slump and no more than 10 inch (254 mm) slump.

1.04 SUBMITTALS

- A. General: Submit the following items in accordance with Conditions of Contract and Division 1, Section "Descriptive Submittals."
- B. Test Reports: Submit test reports required under Quality Assurance as well as the following:
 - 1. Laboratory analysis of each soil material proposed for fill and backfill from on-site and borrow sources.
 - 2. One "Optimum Moisture - Maximum Density Curve" for each soil material.
 - 3. Report of actual unconfined compressive strength and/or results of bearing tests of each stratum tested.
- C. Shoring Design: Contractor shall submit a proposed shoring design (drawings and calculations) prior to start of construction. Design shall be done and stamped by a registered engineer.

1.05 QUALITY ASSURANCE

- A. Sandia National Laboratories (SNL) will engage a soil testing and inspection service for quality control testing during earthwork operations. Should initial tests of Contractor's work indicate noncompliance with the specification, the Contractor shall make corrections as directed. Retesting required to determine compliance with this specification shall be performed by an approved testing laboratory at the Contractor's expense.

1.06 PROJECT CONDITIONS

- A. Existing Utilities: Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, notify the SDR. Do not interrupt existing utilities without following the Standard Facilities Engineering procedures for utility outage. Provide a minimum of 2 weeks' notice when practical, and await notice to proceed before interrupting any utilities.
- B. Known Utilities: Type and location of known existing utilities and obstructions which are shown on the drawings are approximate, but are based on the best information available. Protect these and other utilities which are made known to General Contractor prior to excavation. Determine exact location of all known utilities by performing exploratory hand excavation to expose the utility. Hand excavate at least 5 feet (1.5 m) each side of the indicated location unless the utility is located sooner. Remainder of excavation shall be completed only after the SDR has approved location of known utilities. When electrified utilities are to be removed, safety precautions specified under the procedure for unknown utilities shall be adhered to.

If movement of traffic or public safety makes it necessary to backfill an exploratory excavation after the utility has been located, a suitable marker shall be installed to permanently mark the location.

- C. Unknown Utilities: In the event that unidentified conduits, concrete encased ducts or pipes are encountered that must be removed, all work on that part of the job will stop until the SDR is contacted and resumption of work is authorized.
- D. Underground Telephone Cable: Where an underground telephone cable is shown on the Contract drawings, NO excavation is to be attempted in that vicinity until the line is properly located and staked by the Air Force Communications Service (AFCS). If an unknown cable is identified as a telephone cable during an excavation, all excavation is to cease until the AFCS identifies and properly stakes the cable locations in the vicinity of the excavation. (For assistance call 844-8411.)
- E. Use of Explosives: The use of explosives is not permitted.

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- F. Protection of Persons and Property: Flag and barricade open excavations occurring as part of this work. Protect structures, utilities, sidewalks, pavements and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
1. Contractor shall be responsible for protection of personnel and property in the work area for the duration of the Contract.
 2. Keep excavation free of water from any source at all times. Provide and operate pumps if necessary. Remove water from site in manner to avoid damage to adjoining property.
- G. Pollution Control: Use water sprinkling, temporary enclosures, and other suitable methods to limit amount of dust and dirt rising and scattering in the air to lowest practical level.
1. Comply with governing regulations pertaining to environmental protection. Obtain digging permit from the SDR and earth disturbance notification from City of Albuquerque, when required in the Contract, prior to beginning any earthwork.
 2. Clean adjacent structures and improvements of dust, dirt, and debris caused by earth working operations, as directed by the SDR. Return adjacent areas to conditions existing prior to the start of the work.
- H. Street Crossings: Excavations shall be conducted in a manner so as to cause the least interruption of traffic. Maintain half the width of the street open at all times unless prior approval from the SDR has been given to close the street. Request to close a street must be presented in writing to the SDR at least 2 weeks prior to the requested closing date.

1.07 SHORING DESIGN

- A. Shoring Adjacent to Existing Building 858: Design shoring for excavation adjacent to existing Building 858. Design criteria shall be as stated in project report, "Geotechnical Investigation Microsystems & Engineering Sciences Application (Mesa) Complex Sandia National Laboratories, Albuquerque, New Mexico, Project No. 59-010094" by Kleinfelder, Inc., June 26, 2001, with Addendums 1 and 2. Design shall be by a registered Professional Engineer.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

- A. General: Unless otherwise noted on the Contract documents, the existing site soils shall be used for fill and backfill materials. If the on-site soils are found by laboratory test to be unsuitable for fill and backfill material, contact the SDR for direction.

Any additional fill material used must conform with the applicable requirements of this section.

- B. Structural Fill: Structural fill shall consist of a controlled fill placed in areas indicated on the drawings.

1. Structural fill material shall consist of soils that conform to the following physical characteristics:

<u>Sieve Size</u> <u>(Square Openings)</u>	<u>Percent Passing</u> <u>by Weight</u>
3 inch (152 mm)	100
No. 4 (4.75 mm)	50 - 100
No. 200 (600 mm)	10 - 60

2. The plasticity index of material, as determined in accordance with ASTM D4318 shall not exceed 12.

3. The fill material shall be free from roots, grass, other vegetable matter, clay lumps, rocks larger than 3 inches (152 mm), or other deleterious materials. Stripped top soil shall not be used in structural fill.

- C. Retaining Wall Backfill: Retaining wall backfill material shall be free-draining and conform to fill quality requirements as follows:

<u>Sieve Size</u> <u>(Square Openings)</u>	<u>Percent Passing</u> <u>by Dry Weight</u>
3/4 inch (19.1 mm)	100
No. 4 (4.75 mm)	30 - 80
No. 200 (600 mm)	0 - 5

The material should have a plasticity index of less than 5 when tested in accordance with ASTM D4318.

- D. **Selected Clay Backfill:** Selected clay backfill shall be clay material with plasticity index between 10 and 20, approved by SDR.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.
- B. Protect subgrades and foundation soils against freezing temperatures or frost and excessive drying or wetting. Provide protective insulating materials as necessary.
- C. Protection of Personnel: Flag and barricade open excavations occurring as part of this work.
- D. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water run-off or airborne dust to adjacent properties and walkways.

3.02 CLEARING AND GRUBBING

- A. General: Clearing and grubbing will be required for all areas indicated on the drawings to be excavated, improved on or which fill is to be constructed. All cleared and grubbed materials, including trash, shall be deposited at the Kirtland Air Force Base Landfill or as directed by the SDR.
- B. Clearing and Grubbing: Clearing shall consist of removal and disposal of trees, shrubbery and other vegetation as well as brush and rubbish within the areas to be improved and constructed upon. **Tree stumps, matted roots and roots larger than 2 inches in diameter shall be removed from within 6 inches of the surface of areas to receive fill or within 18 inches of finished subgrade in roadways or parking areas.**
- C. Grass and Topsoil: Grass, grass roots and incidental topsoil shall not be left beneath fill area, nor shall this material be used as fill or backfill material.

3.03 EXCAVATION

- A. General: Excavate to contours, shapes, dimensions and elevations required for the work indicated; extend sufficiently to permit form placing, inspection and removal. Undercutting is prohibited.

1. Earth excavation shall consist of excavation and removal of suitable soils for use as structural fill as well as satisfactory disposal of all vegetation, debris and deleterious materials encountered within area to be graded or in a borrow area, or any combination thereof.
 2. Excavated areas shall be continuously maintained in a manner so that surfaces shall be smooth and have sufficient slope to allow water to drain from surface.
 3. All existing man-made fill shall be removed in its entirety.
 4. Width of excavations shall be to dimensions indicated on drawings, with additional space allowed as required for erection and stripping of forms, and inspection of related work.
- B. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of the SDR. Unauthorized excavation, as well as remedial work directed by the SDR, shall be at Contractor's expense.
1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Flowable concrete fill (2000 psi minimum (14 MPa)) may be used to bring elevations to proper position, when acceptable to the SDR.
 2. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classifications, unless otherwise directed by the SDR.
- C. Additional Excavation: When excavation has reached required subgrade elevations, notify the SDR who will make an inspection of conditions.
1. If unsuitable bearing materials are encountered at required subgrade elevations, immediately notify the SDR for direction.
 2. Removal of unsuitable material and its replacement shall be as directed by the SDR.
- D. Stability of Excavations: Slope sides of excavations where possible in accordance with OSHA 1926.650. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

Shore all vertical cuts greater than 5 feet (1.5 m) in depth.

- E. Dewatering: Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding project site and surrounding area. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations.
- F. Storage of Soil Materials: Stockpile excavated materials acceptable for backfill and fill soil materials, including acceptable borrow materials at a location on site as directed by the SDR. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent wind-blown dust.
- H. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F (1.66 degrees C).

3.04 OVEREXCAVATION FOR STRUCTURES

- A. **Overexcavate to provide following minimum depth of structural fill under structures:**
 - 1. **Under concrete mat foundation at MicroFab: provide two feet of structural fill.**
 - 2. **Under concrete spread footings at all structures: provide minimum three feet of structural fill.**
- B. **Overexcavation and structural fill shall extend beyond the perimeter of mat foundation and spread footings a horizontal distance equal to the depth of fill below the base.**

3.05 BACKFILL AND FILL

- A. General: Place acceptable soil material in layers to required subgrade elevations, for each area classification listed below:
 - 1. **Under structures**, use **structural fill**.
 - 2. Under building slabs, use **structural fill**.
 - 3. Behind **basement and** retaining walls, use retaining wall backfill material. **Selected clay backfill shall be placed in the upper 3.0 feet of backfill behind basement walls, except this clay material is not required in those portions of the excavation behind basement walls that are covered by slabs, sidewalks or pavement.**
 - 4. Flowable concrete backfill may be used in lieu of soil when the ability to compact is affected by conditions such as safety or tight conditions.

- B. Backfill excavation as promptly as work permits, but not until completion of the following:
1. Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
 2. Inspection, testing, approval, recording locations and as-built of underground utilities.
 3. Removal of concrete formwork.
 4. Removal of temporary shoring and bracing, and backfilling of voids with satisfactory materials.
 5. Removal of trash and debris from excavation.
 6. Installing permanent or temporary horizontal bracing at horizontally supported walls.
- C. Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, or break-up sloped surfaces steeper than one vertical to four horizontal so that fill material will bond with existing surface.

Prior to placement of fill, notify the SDR who will make an inspection of conditions to verify satisfactory removal of unsatisfactory materials.

Scarify the subgrade to a depth as stated, moisten to optimum moisture content (within 2 percent) and compact as stated.

- D. Placement and Compaction: Place backfill and fill materials in layers not more than 8 inches (203 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 6 inches (152 mm) loose depth for material compacted by hand-operated tampers.
1. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content (**within 2 percent**). Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
 2. Place backfill and fill materials evenly adjacent to structures, piping or conduit to required elevations. Take care to prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping or conduit to approximately same elevation in each lift.

3.06 COMPACTION

- A. General: Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.
- B. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils) determined in accordance with ASTM D1557 and not less than the following percentages of relative density, determined in accordance with ASTM D4253 and D4254, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).
 - 1. Under Structures, Building Slabs, and Steps: Compact the top 12 inches (305 mm) below subgrade and each layer of backfill or fill material at 95 percent maximum dry density unless otherwise indicated on the drawings. (Exception: Utility trenches under pavements; compact the top 6 inches (152 mm) at 95 percent maximum dry density and each layer of backfill or fill material below subgrade at 90 percent maximum dry density unless otherwise indicated on the drawings.)
 - 2. Fill and native soils outside the limits of structures and outside paved areas: compact to 90 percent maximum dry density.
- C. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material, to prevent free water appearing on surface during or subsequent to compaction operations. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
- D. Weather Limitations: **Structural fill shall not be placed when the atmospheric temperature is below 35 degrees Fahrenheit. When the temperature falls below 35 degrees, all areas of completed work shall be protected against detrimental effects of ground freezing and any areas damaged by freezing shall be reconditioned and compacted in accordance with the stated requirements.**

3.07 GRADING

- A. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surfaces within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.
- B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes and as follows:

1. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10 foot (30.5 mm) above or below required subgrade elevations.
 2. Walks: Shape surface of areas under walks to line, grade and cross-section, with finish surface not more than 1/2 inch (12.7 mm) above or below required subgrade elevation.
 3. Pavements: Shape surface of areas under pavement to line, grade and cross-section, with finish surface not more than 1/2 inch (12.7 mm) above or 1 inch (25 mm) below required subgrade elevation.
- C. Grading Surface of Fill Under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/2 inch (12.7 mm) when tested with a 10 foot (3 m) straightedge.
- D. Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.

3.08 MAINTENANCE

- A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.
- B. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.
- C. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.09 DISPOSAL OF EXCESS AND WASTE MATERIAL

- A. Transport excess excavated material to designated soil storage areas on Kirtland Air Force Base. Waste areas will generally be within 2 miles (3 km) of project site. Stockpile soil or spread as directed by the SDR.

3.10 CONSTRUCTION OBSERVATION AND TESTING

- A. **A representative of the testing agency shall provide continuous on-site observation and testing during placement of structural fill.**

B. Tests of structural fill will be made at the following minimum rates:

- 1. One field density test for each 500 square yards of original ground surface prior to placing fill.**
- 2. One field density test for each 250 cubic yards of fill placed or each layer of fill for each work area, whichever is the greater number of tests.**
- 3. One moisture density relationship test (proctor) for each type of material used as determined by sieve analysis and plasticity index, in accordance with ASTM D1557.**

3.11 SHORING

- A. Install shoring in accordance with approved design and shop drawings.**
- B. Continuously monitor existing Building 858 during construction for any evidence of movement. If evidence of movement is observed, cease operations and notify SDR.**

3.12 RECORD DRAWINGS

- A. The Contractor shall supply one red-lined set of as-built drawings which identify the actual location of utility lines installed and the horizontal location and depth of all existing lines encountered during construction. Utilities shall be dimensioned from the nearest permanent structure.**

END OF SECTION